

User Manual

60 GHz mmWave Wireless Communications Module

Model : FCM604

P/N : FCM60402

Read this instruction manual carefully and use this product correctly.
Keep this manual so as not to lose it.

Fujikura Ltd.

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1. Introduction

1.1. Introduction and Overview

The FCM604 is a wireless communication module. This module has a high transmission power, wide frequency range of 60 GHz millimeter wave (mmWave), and a beam steering function with an integrated 64Tx+64Rx patch array antenna consisting of 16 RF ports and 4 sub-array patch antennas per port. ~~16+16 patch array antenna.~~ The module is targeted at data and telecommunication infrastructures such as fixed wireless access (FWA), residential broadband access, front-haul network, backhaul network, and other applications required for high-speed data transmission.

Figure 1 shows a block diagram of the FCM604, consisting of a baseband processor, radio front-end circuit and phased array antennas. The data interface of the module is 2-lane PCIe Gen2 with an I-PEX 20-pin coaxial cable connector. The module operates on a single +12 V DC supply only. The module contains a metal chassis to reduce thermal resistance and has several screw holes to fix an optional heatsink to the chassis. Combined with an external Linux host processor, the module enables building a complete communication system.

2. Key Features

- ❑ Data transfer using un-licensed 60 GHz band
- ❑ High combined output power of +40 dBm max (EIRP) with wide frequency range (57-66 GHz)
- ❑ Beam steering with integrated patch array antenna
- ❑ Point-to-multipoint (PTMP) wireless connectivity
- ❑ Modulator/demodulator supports IEEE 802.11ad coding schemes (MCS) 0-12
- ❑ Supported data rates of PHY layer up to 4.62 Gbps @ MCS 12
- ❑ RoHS compliant

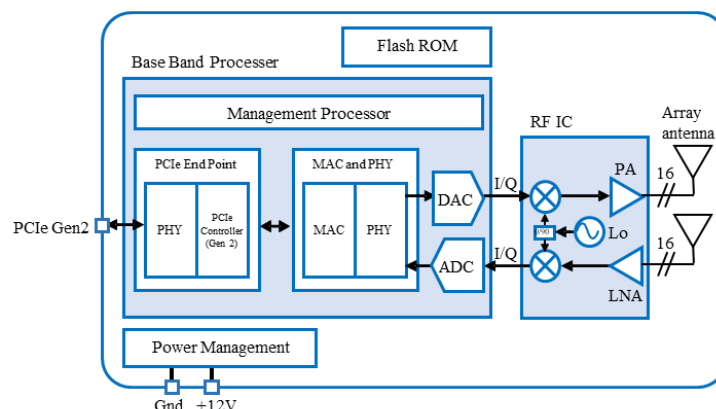


Figure 1-1 Block diagram of FCM604 60 GHz mmWave wireless communication module

1.2. Before Use

This user manual explains how to use the 60 GHz mmWave wireless communication module "FCM604" (hereinafter referred to as this product).

Read this user manual first before using this product. It helps you understand the basic handling method. This user manual also indicates items that should be observed to prevent injury to persons and damage to property, and to use this product safely.

The meanings of the indications and pictograms are as follows. Make sure you understand the contents before reading the main text.

Be sure to follow these instructions for safe use.



WARNING

This indicates that ignoring this warning and handling this product incorrectly may result in death or serious injury to persons.



NOTICE

This indicates that ignoring this warning and handling this product incorrectly may result in injury to persons or damage to property.

Requests

This indicates that ignoring this warning and handling this product incorrectly may result this product is not able to achieve its original performance or stop functioning.



This indicates instructs the actions of unspecified general users.



WARNING

HOT SURFACE



FORBIDDEN

BREAKUP

- The contents of this user manual are subject to change without notice.
- The illustrations and photographs in this user manual may differ from the actual product.
- We are not responsible for any direct or indirect damage caused by relying on the contents of this manual or this product, except for damages directly related to the manufacture of this product.

1.3. Packaging

The individual packaging is designed to accommodate two units of this product. There are no accessories included with this product other than the main unit.



Figure 1-2 Opening Packaging

Requests



When unpacking, be cautious of static electricity. This product can malfunction or become damaged due to static electricity. When removing this product, ensure that you discharge any static electricity from your body.

2. Safety precautions

To use this product safely, be sure to observe the following points.

 WARNING	
	Handling procedure for smoke emission If this product emits smoke or an unusual odor, stop the power supply to this product. Continuing to use this product while it is in an abnormal state may result in fire or electric shock.
	Handling procedure for product damage If this product is dropped and shows any external abnormalities, stop supplying power to this product immediately. Continuing to use it in this condition may cause fire or electric shock.
	Prohibition of modification Do not modify this product. Doing so may cause fire, electric shock, or malfunction.
	Prohibition of Use with Non-Specified Power Sources Make sure that the power supply voltage to this product is within the specified range. Supplying voltage outside the specified range may damage this product and cause fire or malfunction. Refer to this manual for information on the power supply to be used.
	Prohibition of Power Wiring Work While Energized Do not insert or remove while the power is on. There is a risk of electric shock.
	Use the correct wiring materials for connections Use appropriate wiring materials for power connections, such as those rated for the correct voltage, current, and insulation withstand voltage. Using incorrect materials may cause fire or electric shock.
	Prohibition of Disassembly Do not disassemble this product. Doing so may cause fire, electric shock, or malfunction.
	Restriction using in each country The national regulations in each country of operation should be reviewed prior to installing/operating this product to ensure the equipment will be following national regulations.
	Do not touch with wet hands Do not touch this product with wet hands. There is a risk of electric shock.

Handling procedure if water enter this product

If water enters the interior of this product, stop supplying power to this product immediately. Continuing to use it in this condition may cause fire or electric shock.

Handling procedure if foreign materials enter this product

If foreign materials enter the inside of this product, please stop the power supply immediately. Continuing to use this product may cause fire or electric shock.

Case of performing repairs

Please contact the manufacturer for any repairs to this product. Incorrect repairs may cause fire or electric shock.

**NOTICE****Using with a Heat Sink**

This product is designed to be used with a heat sink. Please make sure that you attach the heat sink before using this product. Using this product without a heat sink may cause unexpected overheating, which could damage surrounding equipment.

High Temperature Warning

When touching this product directly, wait for a while after turning off the power supply. Do not touch this product while it is operating or immediately after turning off the power supply. The heat generated by this product may cause burns.

Radio Wave Emission Warning

While this product is emitting radio waves, do not approach within a 30 cm radius of the emission surface. The radio waves emitted by this product may have adverse effects on the human body.

Prohibition of Disassembly

Do not disassemble this product. Once disassembled, compliance with radio wave regulations cannot be guaranteed.

Instructions of Disposal

When disposing of this product, please follow the law and request disposal by a special industrial waste management company.

3. Part Names and Functions

3.1. Appearance

The appearance of this product is shown below.

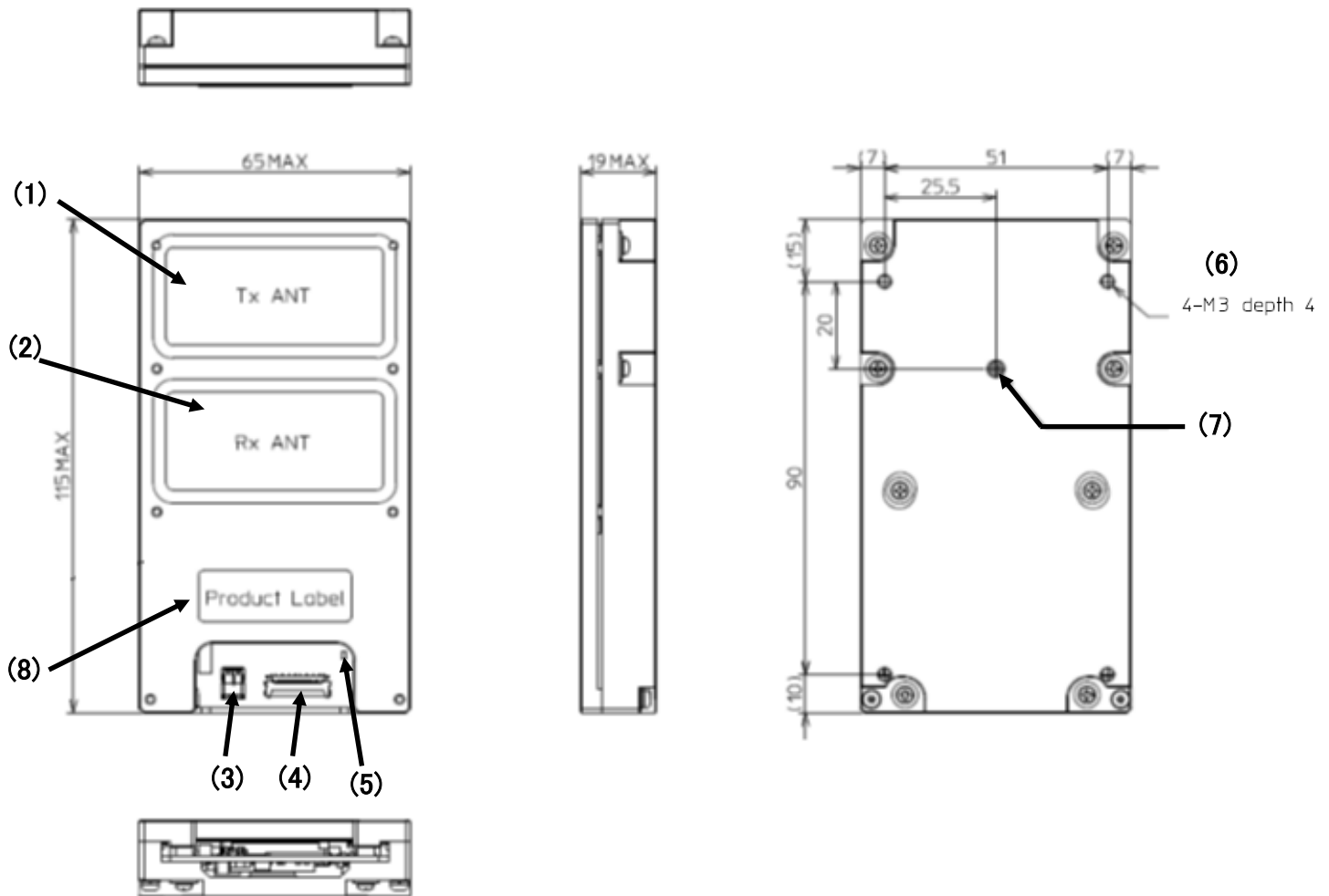


Figure 3-1 Appearance

3.2. Part Names and Functions

This section describes the names and functions of each part of this product.

Table 3-1 Explanation of the functions of each part

Name of each part	Function
(1)Transmitter antenna	Transmits a 60 GHz radio signal.
(2)Receiver antenna	Receives a 60 GHz radio signal.
(3)Power supply connector (Receptacle)	The connector for supplying power to this product.
(4)Data interface connector (Receptacle)	The connector for sending and receiving data signals inputs and outputs with this product.
(5)Power Indicator (LED)	Indicates the power status of this product. Powered On : Green Light Powered Off : Light Off
(6) Heat sink fixing screw holes	Used to fix this product and heat dissipation components (heat sink, etc.)※1
(7)Case temperature reference point	Indicates the location where the operating temperature of this product is specified.
(8)Product Label	Indicates this product label including Model, P/N, S/N and FCC ID.

※1 Fixing screws are not included, please prepare your own suitable screws for installation.

4. Cable Connection

4.1. Power Supply Cable

Figure 4-1 shows the appearance of the recommended DC power cable. Table 4-1 shows the parts list for the power supply cable. The use of UL 10368 (UL number) and AWG#24 (wire size) wires is recommended for this product. For details on harnessing, refer to the "Harness Instructions" from the connector manufacturer.

<https://www.hirose.com/en/product/p/CL0666-5101-6-13>

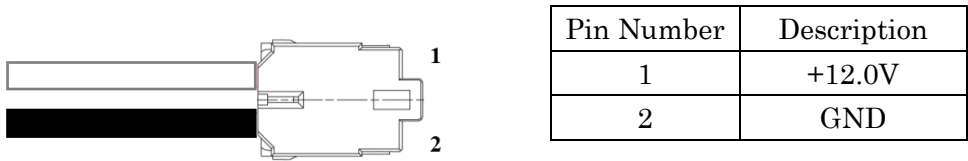


Figure 4-1 Pin assignment of power supply cable with connector

Table 4-1 Parts list for power supply connector

No.	Part	Model	Supplier	Remark
1	Receptacle	DF61Y-2P-2.2V(23)	HIROSE ELECTRIC	Included in this product
2	Socket	DF61Y-2S-2.2C(13)	HIROSE ELECTRIC	AWG#24
3	Contact	DF65-2428SCF	HIROSE ELECTRIC	

4.1.1. How to Insert the Power Supply Cable

Follow the steps below to insert the power supply cable into the connector. For detailed instructions, refer to the connector manufacturer's guidelines.

<https://www.hirose.com/en/product/p/CL0666-5101-6-13>

- ① Set the socket so that the four friction locks on the front, back, left and right of the socket are in contact with the header.

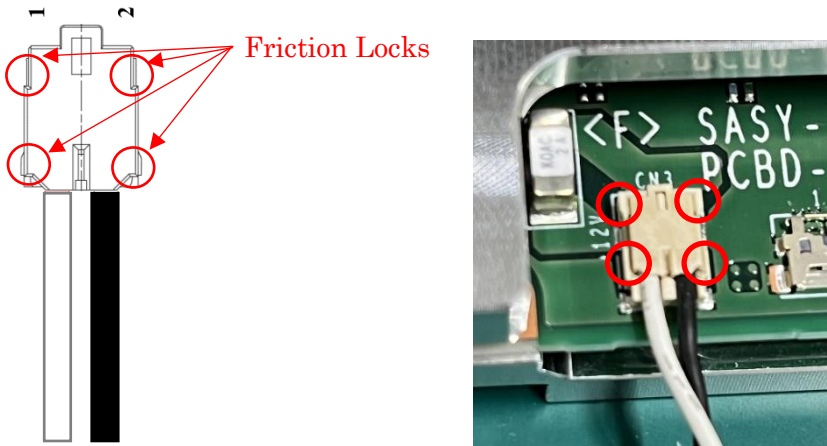


Figure 4-2 How to set the socket

- ② Press the center of the socket to fit it.

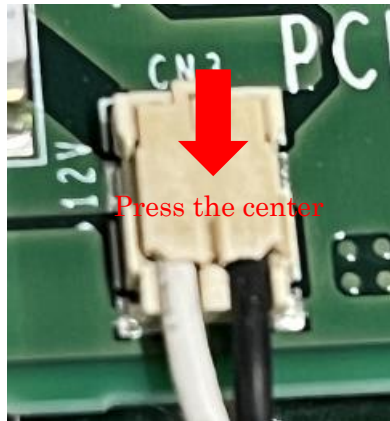


Figure 4-3 Inserting a socket

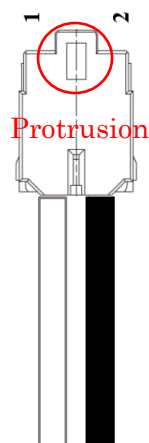
- ③ Make sure the crimp socket is securely fitted. If there is a bulge on one side or the mating is diagonal, remove the mating and re-fit it again. Please refer to Section 4.1.2 for how to remove the fitting.

4.1.2. How to Remove the Power Supply Cable

Follow the steps below to remove the power supply cable into the connector. For detailed instructions, refer to the connector manufacturer's guidelines.

<https://www.hirose.com/en/product/p/CL0666-5101-6-13>

- ① Place your finger or nail on the protrusion for releasing the socket, lift the protrusion, and then lift the entire socket to remove it. When removing this product, be sure to use the protrusion for releasing the mating. If you pull on the cable and remove it forcibly, there is a risk of wire breakage and damage to the connector.



Lifting Protrusions



Figure 4-4 How to remove the socket



WARNING



Do not insert or remove while the power is on. There is a risk of electric shock.

4.2. Data Interface Cable

The data interface of this product complies with the PCI Express Base Specification (Rev. 2.1) and connects via an I-PEX 20-pin coaxial cable connector. Figure 4-5 shows the appearance of the recommended data interface cable. The recommended coaxial cable size is AWG#40, and the characteristic impedance must be 45 ohms. Table 4-2 shows the list of parts used. Connect this product according to the pin arrangement shown in Table 4-3.

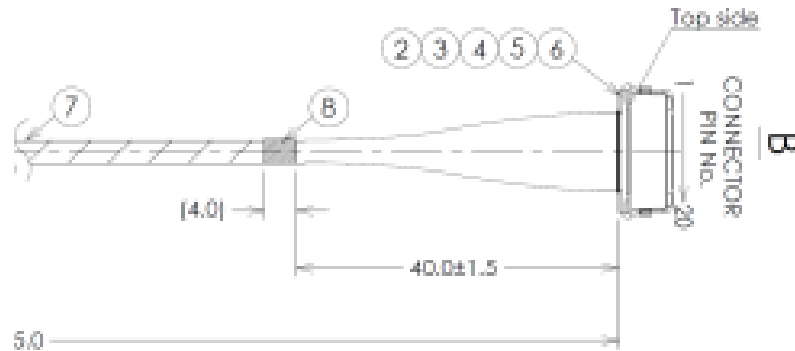


Figure 4-5 Appearance of the recommended data interface cable

Table 4-2 Parts list for data interface cable

No.	Parts	Model	Supplier	Remark
1	Receptacle	20849-020E	I-PEX	Included in this product
2	Plug housing	20847-020T	I-PEX	
3	Plug shell-A	3427-0101	I-PEX	
4	Plug lock bar	20848-020T	I-PEX	
5	coaxial cable	AWG#40	-	Z = 45 ohms

URL <https://www.corp.i-pek.com/en>

Table 4-3 Pin assignment of data interface connector

No.	Pin Name	I/O *1	Description*2
1	GND	—	Ground
2	REFCLK+	I	Reference Clock (Differential pair)
3	REFCLK-	I	
4	GND	—	Ground
5	PET+0	I	Transmitter differential pair on PCIe host side (Lane 0)
6	PET-0	I	
7	GND	—	Ground
8	PER+0	O	Receiver differential pair on PCIe host side (Lane 0) 【AC coupling】
9	PER-0	O	
10	GND	—	Ground
11	PET+1	I	Transmitter differential pair on PCIe host side (Lane 1)
12	PET-1	I	
13	GND	—	Ground
14	PER+1	O	Receiver differential pair on PCIe host side (Lane 1) 【AC coupling】
15	PER -1	O	
16	GND	—	Ground
17	PERST#	I	Reset
18	CLKREQ#	O	Clock request signal
19	WAKE#	O	Signal for link reactivation signal
20	NC	—	No connection

*1 : “I” and “O” mean inputs and outputs to/from the FCM604, respectively.

*2 : PCI Express Card Electromechanical Specification

4.2.1. How to insert the data interface cable

Follow the steps below to insert the data interface cable connector. For detailed instructions, refer to the connector manufacturer's guidelines.

<https://www.i-pex.com/product/cabline-vs-II>

- ① As shown in Figure 4-6, rotate the lock bar on the plug connector to open it.

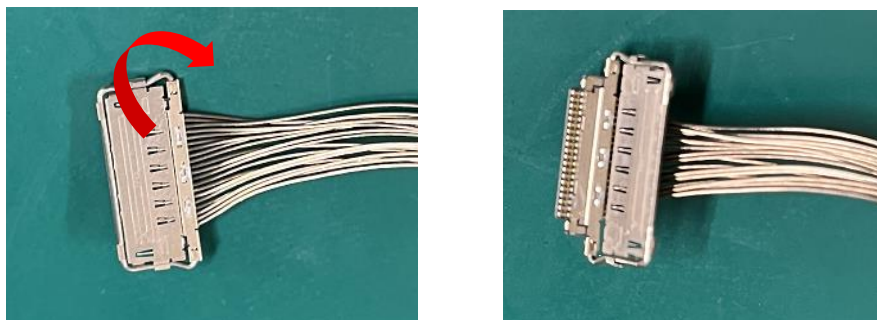


Figure 4-6 Plug connector lock bar

- ② As shown in Figure 4-7, align the reference pin marks of the receptacle connector with the reference pin marks of the plug connector, and then insert the plug connector into the receptacle connector. When inserting the connector, press both ends of the connector horizontally and make sure there is no gap between the plug connector and receptacle connector.

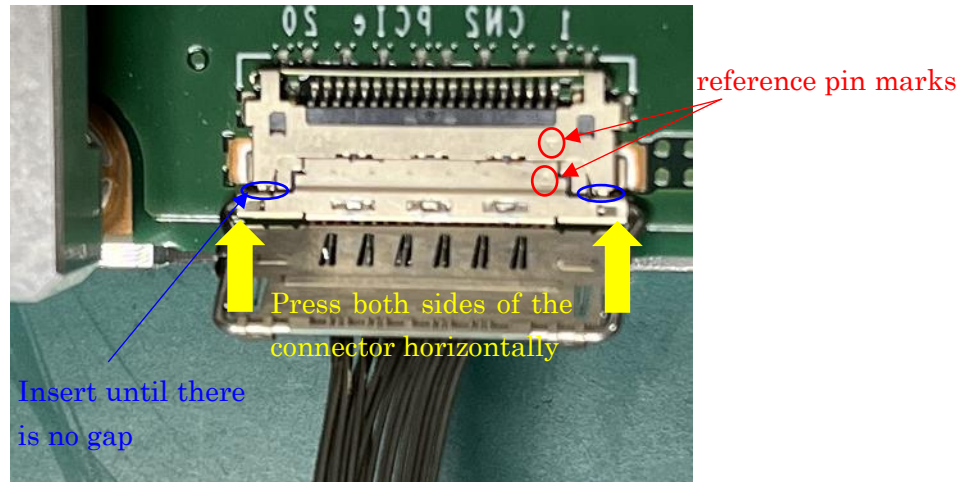


Figure 4-7 Data interface cable connector connection

- ③ Push the red circles in Figure 4-8 toward the board side of this product at the same time, lower the lock bar of the receptacle connector, and lock it.

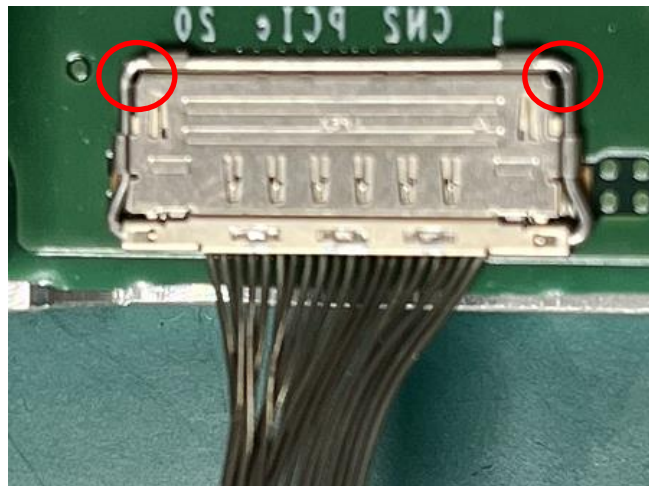


Figure 4-8 Locking cable connector for data interface

4.2.2. How to remove the data interface cable

When removing the data interface cable connector, follow the procedure below. For detailed instructions, please refer to the connector manufacturer's guidelines.

<https://www.i-pex.com/product/cabline-vs-II>

- ① Pull the red circle in Figure 4-9 to the side opposite to the board side of this product to unlock the receptacle connector and rotate the lock bar. When unlocking, do not

pull up the center part of the lock bar to release the lock. There is a risk of deformation of the lock bar and damage to the connector.

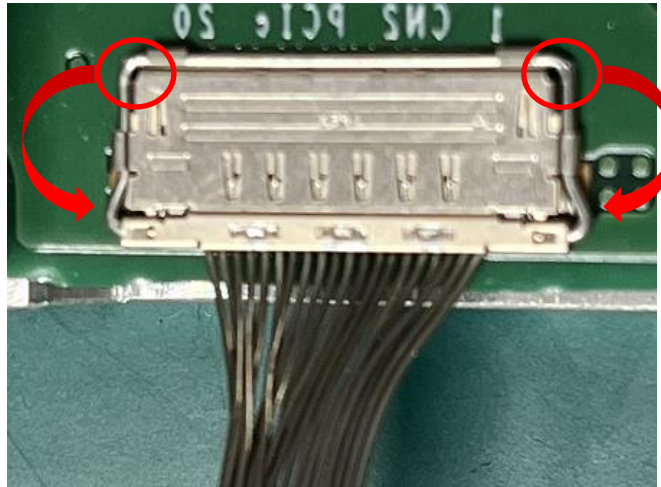


Figure 4-9 Unlocking cable connectors for data interfaces

- ② As shown in Figure 4-10, pull both sides of the plug connector horizontally to remove it. When removing the plug connector, pull both ends horizontally to avoid tilting the plug connector. There is a risk of damaging the connector. Also, do not remove the plug connector by pulling on the cable. Doing so may cause cable breakage.

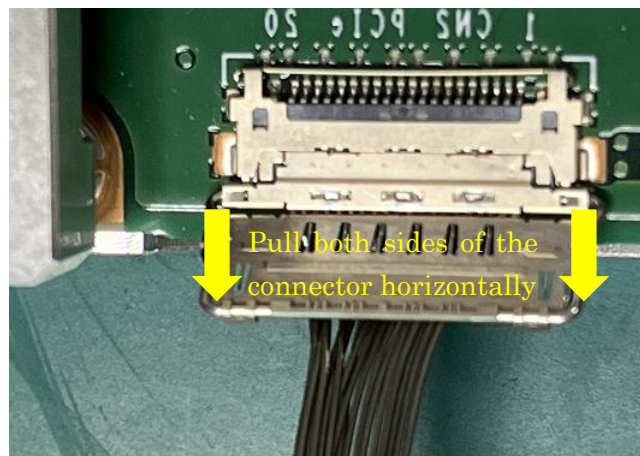


Figure 4-10 Removing the data interface cable



NOTICE



Do not insert or remove while the power is on. There is a risk of malfunction.

5. Specifications

5.1. Basic Specifications

Table 65-1 Basic Specifications

Item	Specification
Size	65mm (W) × 115mm (H) × 19mm (D)
Weight	180 g
Supply Voltage	11.4 ~ 12.6V
Power Consumption	Max 13.8W
Operating Temperature	-30~70°C (Case temperature)

5.2. External Connections

Table 65-2 Specifications of external connections

Item	Connector	Specification
CN2	DF61Y-2P-2.2V(23)	ViSe lock 2 pins
CN3	20849-020E	I-PEX 20 pins

6. FCC Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Caution:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This module complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines. This module must be installed and operated keeping the radiator at least 30cm or more away from person's body.

7. INTEGRATION INSTRUCTION

General:

This user manual describes the integration procedure per Sec. 2.2 to 2.12 of KDB 996369 D03.

List of applicable FCC rules:

This module complies with part 15.255 of the FCC rules.

Summarize the specific operational use conditions:

This device is not to be operated on aircraft except for the conditions listed on FCC CFR §15.255 (b).

RF exposure considerations:

This module complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines. This module must be installed and operated keeping the radiator at least 30cm or more away from person's body.

Antennas:

The module itself has antenna.

Label and compliance information:

The module is labeled with its own FCC. If the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. In that case, the final end product must be labeled in a visible area with the following:

"Contains FCC ID: 2BOE2FCM604"

The host manual shall include the following regulatory statement:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This module complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines. This module must be installed and operated keeping the radiator at least 30cm or more away from person's body.

Information on test modes and additional testing requirements:

Testing of the host product with all the transmitters installed - referred to as the composite investigation test- is recommended, to verify that the host product meets all the applicable FCC rules. The host manufacturer can use the software to make the 60GHz transmit continuously.

Additional testing, Part 15 Subpart B disclaimer:

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant (FCC Part FCC15.255), and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification.

The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Note EMI Considerations:

We recommend using "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties. The host manufacturer is responsible for ensuring compliance with the applicable FCC rules for the transmitters operating individually and simultaneously. This includes compliance for the summation of all emissions from all outputs occupying the same or overlapping frequency ranges, as defined by the applicable rules.

How to make changes:

Only the grantee is permitted to make permissive changes. Please contact us.



Fujikura Ltd.

Electronic Technologies R&D Center

Millimeter-wave Business Development Department

1440, Mutsuzaki, Sakura-shi, Chiba 285-8550, Japan

E-mail : mmwavetech@jp.fujikura.com

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